Demography of a confined elephant population and the potential consequence of translocation: the case of Sweetwaters Game Reserve, Kenya

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Abstract

The demography of elephants at Sweetwaters Game Reserve in Kenya was studied between February and July 2001 and the results were compared with a similar study done in 1992–1993. This study documented demographic changes in the population following 10 years of confinement. The 120 elephants encountered comprised 100 elephants in 12 cow–calf groups and 20 independent bulls aged 10 years and older. Groups involving cows accounted for 59% of elephant sightings. The structure of the population was represented by 9.6% calves aged 1 year and younger, and 49.6% females aged above 12 years. In line with models of an elephant population increasing at a high rate, an estimated 94% of the females in the population were observed to associate closely with calves thought to be their offspring. The number of groups had increased, but the average group size had decreased between 1993 and 2001, which indicates that the population was secure.

Additional key words: fencing, recruitment, age structure, sex ratio

Résumé

On a étudié la démographie des éléphants de la Réserve de Faune des Sweetwaters, au Kenya, entre février et juillet 2001, et on a comparé les résultats à ceux d'une étude similaire réalisée en 1992-1993. Cette étude documentait les changements démographiques de la population suite à 10 années de confinement. Les 120 éléphants rencontrés se partageaient entre 100 éléphants divisés en 12 groupes composés de femelles et de jeunes et 20 mâles indépendants âgés de 10 ans et plus. Les groupes de femelles comptaient pour 59% des observations d'éléphants. La structure de la population comptait 9,6% de jeunes d'un an ou moins et 49,6% de femelles âgées de plus de 12 ans. Correspondant au modèle d'une population croissant à un rythme élevé, on estime que 94% des femelles de la population étaient étroitement associées à des jeunes dont on pense qu'ils étaient les leurs. Le nombre de groupes avait augmenté, mais la taille moyenne du groupe avait diminué entre 1993 et 2001, ce qui indique que la population était en sécurité.

Mots clés supplémentaires : fencing, recrutment, structure d'âge, sexe ratio

Introduction

Populations of the African elephant, *Loxodonta africana* (Blumebach, 1797), in East Africa suffered seriously from poaching in the 1970s and 1980s (Douglas-Hamilton 1987; Poole et al. 1992). Poaching caused not only a decline in elephant numbers but also unprecedented distortion of the social organization of affected populations (Chanda and Tembo 1993; Njumbi 1993; Sherry and Tattersall 1996). In Laikipia District in Kenya, the elephant problem of crop raiding and loss of human life and property due to elephant attacks began when the elephants moved south from Isiolo and Samburu Districts in the 1950s in search of food and water (Thouless 1993), and it intensified in the 1970s due to intense poaching (Poole et al. 1992; Thouless 1993). Tight security in private ranches such as the Ol Pejeta Ranch in Laikipia Dis-

trict provided refuge to the fleeing elephants. However, with time the mostly fenced ranches could not support the growing numbers. As a result, elephants started breaking out of the ranches in search of resources such as food, resulting in high management costs. Outside the sanctuaries and ranches, human population continues to increase and with it greater demand for land. As the proximity of human settlement and activities to the conservation areas increases, human–wildlife conflicts, particularly with elephants, intensifies. Human–elephant conflict in Laikipia District is serious as the district has the country's largest elephant population outside protected areas, estimated at 3241 (Omondi et al. 2002a).

In Sweetwaters Game Reserve, crop raiding, destruction of property, and loss of human life have resulted in negative attitudes toward wildlife conservation and the high cost of maintaining fences. These factors led the Kenya Wildlife Service (KWS) to search for a feasible wildlife management solution. Under this backdrop KWS adopted elephant translocation as a management tool to address the problems while securing a future for the elephants.

Here we discuss the results of a demographic study of individually identified elephants and compare our findings with those of a similar study conducted eight years earlier (Omondi et al. 1993). We also estimate the size of the population in 1989 at the time of fencing, provide the age and sex structure of the population after the subsequent 2001 translocation of 56 elephants from Sweetwaters, and predict the likely consequences for the population that will result from these elephants having been removed.

Study area

Sweetwaters Game Reserve, located about 25 km west of Nanyuki, Kenya, covers an area of approximately 95 km^2; it is completely fenced electrically (fig. 1). The fence was constructed in 1989 when the reserve was opened as a rhino sanctuary and black rhinos were brought in from Lake Nakuru National Park. The fence was intended to provide tight security for the black rhinos to promote population recovery. The fencing also confined many other mammals including elephant, buffalo, giraffe, zebra and waterbuck. With time, the tight security provided a favourable environment for reproduction, and soon populations of most of the confined mammals increased significantly (Birkett et al. 2000). In the late 1990s, the reserve management expressed concern about the rising occurrence of human–wildlife conflict. Male elephants were largely identified by management as responsible for the escalation. Thouless and Sakwa (1995) reported that bull elephants exhibited a greater tendency than cow–calf groups to try to break through electric fences.

Confinement has also eventually led to habitat destruction. Vegetation in the reserve consists of *Euclea divinorum*, which dominates much of its southern half, while *Acacia drepanolobium* bush and expansive grasslands cover much of its north. Elephants were reported to exert great pressure on mixed stands of these species, which are the preferred breeding grounds of the endangered black rhino (Birkett et al. 2000). Dying *Balanites glabra* shoots, particularly in the central and northern parts of the reserve, are also an emerging sign of declining habitat quality and quantity (Ogola, pers. obs.).

Methods

We carried out a reconnaissance survey at the beginning of the study to locate places such as water points, salt licks and a central marshy area that park management and tour guides knew the elephants frequented.

Collection of demographic data

Elephant encounters were opportunistic, but searches were concentrated around water points, artificial salt licks and the marshy area in the central part of the reserve. We used basic individual elephant recognition techniques (Laws 1966; Douglas-Hamilton 1972; Moss 1988) to study the demographic status of the population. We developed an identikit of the population based on unique features on elephant ears such as nicks, notches, holes and in some cases general ear shape. Additionally, notes on any other conspicuous features such as patches of dry tissue on the body, nature of tusks or physical deformities were made in field notes to improve the accuracy of the identikit.

Physical features such as pronounced sexual dimorphism in body size (for adults), external genitals, side view of head shape, and nature of tusks were used to sex the elephants (Moss 1996). The shoulder-height index (Laws 1966), visually determined in combination with other features (Laws 1966; Douglas-Hamilton 1972; Moss 1996), was used to determine their age. The same method for registering individual elephants

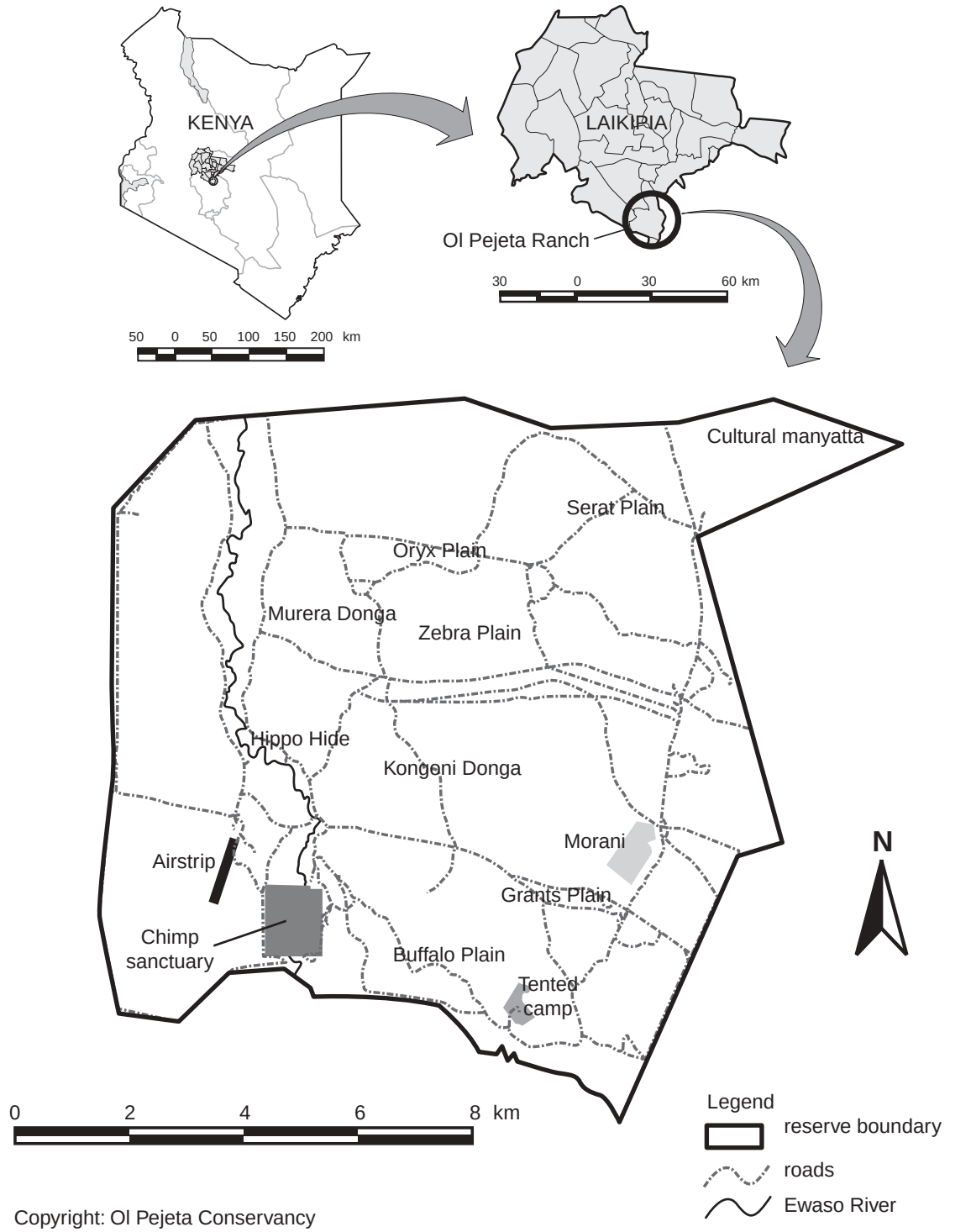

Figure 1. Sweetwaters Game Reserve in Laikipia District lies in the southern part of a contiguous complex comprising fenced ranches and free wildlife ranges.

was used by Omondi and colleagues in the early 1990s to study the demography of the population. The use of similar methodology in the two studies made it possible to compare the results.

Determination of maternity

Elephants live in a semi-closed matrilineal system in which females stay in their natal groups while males go out after attaining maturity (Douglas-Hamilton 1972; Moss 1988). Consequently, quantified data on association between cows and calves makes it possible to delimit family units and to predict maternity. At each encounter of a cow–calf group, considerable time was spent with the group to establish sibling relationship or maternity. Maternal relationship was confirmed when a cow was seen associating closely with a calf during all sightings of the pair and when that calf was not seen to associate closely with another cow. These relationship inferences may not always be accurate, as caregiving by non-mothers, known as allomothering or foster-mothering, in case of death has been reported for elephants (Lee 1987). However, we spent considerable time with each group during each sighting to determine mother–child relationship, and such associations were considered only when they were observed in every sighting of the group.

Results

During the 2001 study, 120 elephants in 12 cow–calf groups and individual bulls aged 10 years and above were catalogued (table 1). Groups with cows accounted for approximately 59% of all group sightings, and group sizes remained relatively stable throughout the study period. The average population group size was 7.02 (n = 136, range = 1 to 34); for bull groups the mean was 1.64 (n = 33) and for cow–calf groups mean was 8.43 (n = 103). Among the 12 cow–calf groups, 10 were discrete and exhibited localized habitat-use patterns, which made it further possible to distinguish between groups. However, the other two groups, which were larger in size and had the oldest matriarchs, were observed to aggregate consistently. We established 17 mother–child relationships by keenly monitoring cow–calf associations between 6 cows and 17 calves. Calving interval, obtained by averaging the number of years between any two calves thought to be of the same mother, was estimated at 3.82 ± 1.02 years (n = 11, range = 2 to 4 years).

Although available data were inadequate for determining age at first reproduction, one female of about 12 years gave birth during the study. Omondi et al. (1993) had found 61 elephants in 5 cow–calf groups in the following age structure: 16 elephants aged less than 5 years, 24 aged 5–10 years, and 21 older than 10 years. In addition, 22 bulls comprising 4 aged 10–15 years and 18 aged over 20 years were counted in the previous study. The age structure of the population obtained by the two studies was significantly different (χ^2 = 23.811, $p < 0.001$); there were more calves younger than 5 years of age but fewer calves aged 5–10 years in 2001 than in 1993. There were more elephants over 10 years of age in 2001 than in 1993: 43 in 1993 and 65 in 2001. In addition, the number of cow–calf groups had also increased while the average group size had decreased: 5 groups with 21.2 mean group size in 1993 and 12 groups with 8.43 mean size in 2001.

Using demographic data from 1993 and 2001, it was possible to estimate the number of elephants that were initially confined by the electric perimeter in 1989. All elephants aged over 10 years were probably initially confined when the fence was put up. Although there were some elephant break-ins immediately after the fence was erected, later fence-breakers were known and times of breakages predictable (J. Koskei, pers. comm.). The age structure obtained through individual identification in 2001 suggests an estimate of 62 elephants in 1989, including 27 females then aged at least 12 years. Consequently, the average annual recruitment in the 10-year period was estimated at about 6 calves, which represents an annual growth rate of approximately 10%.

Discussion

The elephant population in Sweetwaters Game Reserve remained largely confined from 1989 to the present study in 2001, except for initial elephant break-ins and the predictable movements in and out of the reserve by about nine known notorious fence-breaking males.

The increase in the number of cow–calf groups and their decreased average size besides their discrete or localized nature of habitat use indicated that the population was secure (Douglas-Hamilton 1972). The structure of the population was represented by 9.6% calves aged 1 year and less and 49.6% females aged above 11 years, which is taken as the age of first re-

production in most elephant populations (Poole 1996). Such an age structure is consistent with the criteria of a stable population that is increasing at maximum rate (Calef 1988). Nevertheless, the data also suggest that at the time of confinement, the population was not in line with some of Calef's (1988) assumptions of a maximum population growth model such as active reproduction by all adult females and a 50 : 50 sex ratio. In addition, the population may have experienced a reproduction hiatus following fencing, as depicted by the low number of elephants aged 5–10 years, which might have disrupted the social organization of the population.

Table 1. Age and sex structure of the Sweetwaters elephant population before and after the 2001 translocation

	Before translocation		After translocation	
	Female	Male	Female	Male
Age class (years)				
0–4.9	15	33	8	20
5–9.9	3	4	0	2
10–14.9	2	14	0	11
15–19.9	3	3	0	3
20–34.9	24	3	13	1
35–49.9	12	4	6	0
50+	0	0	0	0
Total	59	61	27	37
Sex				
Calves & subadults less than 20 years (no.)	23	54	8	36
Sex ratio	1	2	1	5
Adults 20 yr and older (no.)	36	7	19	1
Sex ratio	5	1	19	1

The disproportionate sex ratio and the possible negative lock-in lock-out effect of fencing on reproduction reinforce the view that the many free-ranging elephants outside the reserve continued to regulate the population, at least during the early 1990s before movements in and out of the reserve became predictable and involved known individuals. Kerr (1978) showed that in a population growing at maximum rate about 95% of the female elephants are either pregnant or lactating. In Sweetwaters Game Reserve, 94% of the cows of reproductive age were observed to associate closely with calves that were thought to be their offspring, a result that strongly suggests that the population was increasing at a high rate. The growth rate that we estimated to have occurred between 1989 and before the translocation in 2001 is very high, and our hypothesis is that part of that growth was due to immigration of elephants immediately following the completion of the fence.

Nevertheless, the high growth rate of the population, inferred from the associations between cows and calves, was thought to be a result of natural increase due to improved security from the fence and a daily network of ground patrols. It must, however, be pointed out that the minimum calving interval of 2 years could have arisen due to underestimation of age of some calves. A calving interval of 2.9 years, which is not largely different from our estimate, has been reported (Poole 1996).

The differences in age structure obtained from the results of the previous and present studies may be explained by natural recruitment, initial break-ins following the confinement, the translocation of 10 elephants in 2000, and the death of 3 elephants the same year (James Koskei, pers. comm.). The bulls that were identified in the previous study and not located in this one are thought to have either died or broken out of the reserve. It is also possible that some of those bulls were translocated to Meru National Park in 2000, although we could not verify this as individual translocated elephants were not identified.

After 57 elephants including 5 casualties were translocated to Meru National Park (Omondi et al. 2002b), leaving a biased adult sex ratio of 19 females to 1 male, the growth rate of the population is likely to be low. Despite the fact that the number of female individuals in a population plays a significant role in influencing population growth, it is possible that the Sweetwaters population may experience a reproduction hiatus due to the skewed adult sex ratio. The oldest male left in the population was aged 20–25 years, an age at which males do not take part in 'serious' copulation (Moss and Poole 1983).

It is possible, however, that this hiatus may not happen, given elephants' reproductive flexibility: in

disturbed populations, males 20–25 years old have been reported to enter musth and mate (McKnight 2000 for the African elephant and Sukumar 1989 for the Asian elephant).

Furthermore, identifying and subsequently translocating discrete family units, which is thought to be important for reducing any trauma associated with translocation in the donor population, is likely to decrease the chance of a break in reproduction. Also, given the high number of free-ranging elephants in the district, other mature bulls may break into the reserve to occupy 'mating space' left by the translocated bulls, albeit with high maintenance costs.

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